

WHAT IS CLAIMED IS:

1. A distillation system with individual fractionator tray temperature control, which comprises:

(a) at least one distillation column having a plurality of fractionation trays, and having feed input means, liquid removal means, and vapor removal means, wherein at least a majority of said plurality of trays include at least one of a heating element and a cooling element;

(b) control means for separate control of each of said heating element and said cooling element for said trays having at least one of a heating element and a cooling element.

2. The distillation system of claim 1 wherein

there are a plurality of distillation columns functionally connected to one another.

3. The distillation system of claim 2 wherein there are a specified number of distillation columns and each distillation column after a first column has a vapor removal means from a preceding distillation column connected to its feed input means.

4. The distillation system of claim 1 wherein said majority of said plurality of trays have both a heated element and a cooling element.

5. The distillation system of claim 1 wherein said cooling element is at least one open area

within said tray, said cooling element having an inlet port for injection of a coolant into said at least one open area within said tray, said at least one open area being a heat absorbent area, and said cooling element having an outlet port for removal of said coolant, from said at least one open area.

6. The distillation system of claim 5 wherein said coolant is a liquid phase change coolant and which further includes injection means for injection of said phase change coolant in liquid form into said inlet port of said cooling element for creation of cooling by phase change from a liquid state to a gaseous state.

7. The distillation system of claim 5 which further includes control means connected to said at least one cooling element and said at least one heating element for programmable automatic control of said injection means to control at least one of on/off flow and rate of flow, and to control at least one of on/off heating and rate of heating, said control means including a programmable device.

8. The distillation system of claim 7 wherein said control means includes software, and said system includes an injection means physical control device, for cyclical on/off control thereof to establish at least one predetermined temperature sequence involving a plurality of

diverse, programmable temperature levels, with means to vary on/off time sequences.

9. The distillation system of claim 6 which further includes a remote reservoir of a phase change coolant connected to said injection means and inlet port wherein said reservoir contains a phase change coolant in a liquid state under pressure.

10. The distillation system of claim 9 which further includes phase change coolant generation means connected thereto.

11. The distillation system of claim 9 wherein a phase change coolant is included and is an

environmentally inert material which absorbs heat upon vaporization and has a boiling point below room temperature at atmospheric pressure.

12. The distillation system of claim 11 wherein said phase change coolant is selected from the group consisting of inert gases, carbon dioxide and nitrogen.

13. The distillation system of claim 5 wherein said cooling element is a heat exchange.

14. The distillation system of claim 1 which further includes at least one membrane cartridge located in a column between trays for membrane filtration.

15. The distillation system of claim 1 which further includes at least one downstream vacuum removal unit located on a last column vapor removal means.

16. The distillation system of claim 1 which further includes at least one upstream liquid combination unit having plural liquid source inlet means, selective controls for operating any one or more of said plural liquid source inlet means, and outlet means connected, at least indirectly, to a first column.

17. The distillation system of claim 16 which further includes an evaporation chamber located between said liquid combination unit and said

first column and connected to liquid combination unit outlet means and to a feed input means of said first column.

18. The distillation system of claim 3 wherein there is at least one valved recycle line connected between two columns to selectively recycle at least a portion of liquid from a downstream column back to an upstream column.

19. The distillation system of claim 1 wherein there are a plurality of temperature sensing means located in at least one column for sensing temperature of plurality of tray levels and are connected to said control means.



20. The distillation system of claim 7 wherein there are a plurality of temperature sensing means located in at least one column for sensing temperature of a plurality of tray levels and are connected to said programmable device for adjusting said heating units and said cooling units to obtain predetermined temperatures.